United States Environmental Protection Agency **Office of Research and Development**

National Exposure Research Laboratory
Research Abstract
Government Performance Results Act Goal: Safe Food

Significant Research Findings:

Human Exposure Measurements: Children's Focus & Support of the Food Quality Protection Act

Scientific Problem and Policy Issues

The Food Quality Protection Act (FQPA) of 1996 requires U.S. Environmental Protection Agency (EPA) to use exposure assessments in the pesticide tolerance setting process. These assessments must consider aggregate exposures of infants and children to pesticides from all sources and all routes. These exposures result from dietary ingestion of pesticide residues in food and drinking water, inhalation of air containing pesticides, dermal (skin) contact with surfaces containing pesticides (indoors and residential lawns), and non-dietary ingestion of pesticide residues from hand- or object-to-mouth activities. Children's exposure to pesticides may be impacted by many factors, including their activities and the microenvironments that they occupy, particularly for the dermal, non-dietary ingestion, and dietary routes of exposure. FQPA requires that future assessments use high quality and high quantity exposure data or models that are based on exposure factors generated from existing, reliable exposure data. Currently, there are very little exposure data that can be used for these purposes. The goal of this research is to develop the protocols and data that are required for assessing children's aggregate exposures to pesticides. In support of FQPA, the initial focus is on potential health threats to children from residential uses of pesticides. However, results from this project provide basic insights into data requirements for assessing children's aggregate and cumulative exposure to all environmental pollutants.

Research Approach

This project is designed to identify the pesticides, exposure pathways, and activities that represent the highest potential exposures to children and the factors that influence these exposures. Research is being performed to develop methods and protocols for conducting exposure measurements for children, to collect data on exposure factors to reduce the uncertainty in the Agency's exposure assessments, and to collect data for use in children's exposure model development and evaluation. To address the objectives of this program, a set of studies was designed to collect information and data in four areas: pesticide use patterns, temporal and spatial distribution of pesticide residues in non-

occupational environments (residences and child care centers), dermal and non-dietary exposure assessment methods and exposure factors, and dietary exposure assessment methods and exposure factors. Studies conducted in this program include:

1. Tests of the Feasibility of Using the Macroactivity Approach to Assess Dermal Exposure,
2. Study to Identify Important Parameters for Characterizing Pesticide Residue Transfer Efficiencies,
3. Use of Fluorescent Tracer Technology to Investigate Dermal Exposure,
4. Study of Pets as Transfer Vehicles of Pesticide Residues Following Lawn Applications,
5. Temporal and Spatial Distributions of Pesticides Following a Crack and Crevice Application in the EPA Test House,
6. Children's Pesticide Exposure Measurements Following Crack and Crevice Applications,
7. Coding the Videotaped Activities of Preschool Children,
8. Collaboration with the CDC and Duval County on Potential Pesticide Exposure of Young Children Living in an Urban Area,
9. Collaboration with HUD to Measure Pesticides in Child Care Centers,
10. Evaluation of Methods to Measure Exposure of Infants and Very Young Children of Farm Workers,
11. Measuring Dietary Intake of Young Children,
12. Characterization of Pesticide Transfer to Foods From Household Surfaces, and
13. Analytical Methods Development for Contaminants in Composite Food Samples.

Each of these studies was designed to collect data to address one or more of the four focus areas of research and the objectives of the program.

Results and Implications

A screening level assessment showed that dermal, non-dietary ingestion, and the dietary ingestion pathways provide some of the potentially highest exposures for young children. Data to quantify exposures from these routes are very sparse, making exposure assessments for these routes the most uncertain. As a result, research studies were developed in this project to collect requisite dermal, dietary, and non-dietary exposure data. A number of key findings have resulted from these studies.

- Tests with the fluorescence tracer technology demonstrated that both the type of surface and the skin condition (e.g. dry versus moist) significantly impact the transfer of pesticide residues to

the skin. Transfer from smooth surfaces was higher than from rough surfaces. Tests to measure transfer of tracers mimicking pesticide residues from toys by simulated mouthing demonstrated the potential importance of this route.

- Measurements of transfer coefficients using cotton dosimeters worn by children in their homes showed that the transfer of pesticide residues following crack and crevice application varied with activity level, duration, and location on the body. The initial data analysis suggests that the macroactivity approach may be appropriate to estimate children's dermal exposure based on activity levels in well-defined microenvironments. The microactivity approach will likely be required to estimate exposure by non-dietary ingestion.
- Results of the feasibility study of the potential for human exposure to pet-transferred diazinon residues following lawn applications showed that transferable residues were measurable in samples of the dog's fur (clippings), fur wipes, and paw wipes up to 15 days after application of the pesticide on the lawn. Transferable residues on the fur after the lawn application were 14 times higher than the background concentrations on the fur prior to the application.
- Analysis of data from a study of ingestion of pesticides in homes following crack and crevice applications suggests that a substantial portion of the total dietary intake of pesticides by young children may occur due to contamination of foods during handling and eating in homes with elevated levels of pesticides.

The pilot studies conducted in this research project have included a substantial effort to evaluate measurement protocols and methods for measuring children's exposure by the dermal, dietary, and non-dietary ingestion pathways. Results of these studies are being used to develop a draft protocol for measuring children's non-occupational exposure to pesticides by all relevant pathways. The draft protocol will be evaluated in future field verification exposure measurement studies. Many of the studies are currently on-going or soon to be completed. Data are being analyzed and will be reported in the coming year.

This research project will provide data and information to meet EPA's Government Performance and Results Act (GRPA) Goal # 3 (Safe Food) and Goal # 8 (Sound Science, Improved Understanding of Environmental Risks, and Greater Innovation to Address Environmental Problems). The outputs from this project will contribute to these goals by providing critical data needed to develop methods and protocols for

assessing aggregate exposure, to develop and evaluate exposure models, and to reduce uncertainties in exposure assessments for children.

Research Collaboration and Publications

The children's exposure measurements and research in support of FQPA are being conducted by scientists from EPA's National Exposure Research Laboratory with support of researchers from the Research Triangle Institute and the Battelle Memorial Institute under contract to the EPA. Additionally, work is being performed in collaboration with the Centers for Disease Control and Prevention (CDC), the Department of Housing and Urban Development (HUD), and the Duval County Florida Health Department. The research project has resulted in peer-reviewed manuscripts and over 30 presentations at symposia and conferences, including the conferences of the International Society of Exposure Analysis and the Society for Risk Analysis. Examples of recent peer-reviewed publications from this research program include:

Akland, G.G, Pellizzari, E.D., Hu, Y., Roberds, M., Rohrer, C.A., Leckie, J.O., and Berry, M.R. Factors influencing total dietary exposures of young children. *Journal of Exposure Analysis and Environmental Epidemiology*, 10(6, Part 2): 710 - 722, (2000).

Cohen Hubal, E.A., Sheldon, L.S., Burke, J.M., McCurdy, T.R., Berry, M.R., Rigas, M.L., Zartarian, V.G., and Freeman, N.C.G. Children's exposure assessment: A review of factors influencing children's exposure, and the data available to characterize and assess that exposure. *Environmental Health Perspectives*. 108(6): 475-486, (2000).

Cohen Hubal, E.A., Sheldon, L.S., Zufall, M.J., Burke, J.M., Thomas, K.W. The challenge of assessing children's residential exposure to pesticides. *Journal of Exposure Analysis and Environmental Epidemiology*, 10(6), Part 2: 638-649, (2000).

Hu, Y.A., Barr, D.B., Akland, G.G., Melnyk, L.J., Needham, L., Pellizzari, E.D., Raymer, J.H., and Roberds, J.M. Collecting urine samples from young children using cotton gauze for pesticide studies. *Journal of Exposure Analysis and Environmental Epidemiology*, 10(6, Part 2): 703 - 709, (2000).

Morgan, M., Stout, D.M. II, and Wilson, N. A feasibility study of the potential for human exposure to pet-borne diazinon residues following lawn applications. *Bulletin of Environmental Contamination and Toxicology* 66(3):295-300, (2001).

Rosenblum, L., Hieber, T., Morgan, J.N. Determination of pesticides in composite dietary samples by gas chromatography/mass spectrometry in the selected ion monitoring mode by using a temperature-programmable large volume injector with preseparation column. *Journal of AOAC International*, 84(3): 891 - 900, (2001).

U.S. EPA (1999) Dermal and Non-Dietary Ingestion Exposure Workshop. Research Triangle Park, NC, Office of Research and Development. EPA/600/R-99/039.

U.S. EPA (2001) Manual of Analytical Methods for Determination of Selected Environmental Contaminants in Composite Food Samples. EPA report (in preparation).

Future Research	The research described here is part of a larger program to support FQPA by collecting data on exposure factors to reduce the uncertainty in exposure assessments for children and by providing data for development of multi-media, multi-pathway exposure models. Draft protocols developed in this project will be evaluated and refined in field verification studies to be performed in Fiscal Years 2003 and 2004. The field verification studies will be designed to develop reliable protocols for estimating exposure for all relevant pathways and children's age groups, demonstrate the validity of the protocols in exposure measurement field studies, develop accurate exposure factors and define the uncertainty associated with these factors, and develop a core data set of high quality exposure concentration measurements.
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